

## REMARKS

Claims 1-7, 9, 12-22 are pending in the present application. Claims 8, 10, and 11 have been canceled. Claims 1-7, 9, and 12 have been amended. Claims 13-22 have been added.

1. Claims 1, 2, 6, 7, and 12 stand rejected under 35 U.S.C. §103(a) as being unpatentable, whereby independent claim 1 has been found to be unpatentable over Prior Art in view of DE3841874.

Examiner contends that Prior Art discloses all the limitations of claim 1 except for the limitation that the finest particles are “then introduced into the combustion chamber via at least one dedicated pipe and burned by at least one dedicated burner.” Examiner further contends that DE3841874 shows this limitation for the purpose of improving the firing process. Consequently, Examiner finds that “[I]t would have been obvious to one of ordinary skill in the art to modify Prior art by including which are then introduced into the combustion chamber via at least one dedicated pipe and burned by at least one dedicated burner, the dedicated burners, ... as taught by DE3841874 for the purpose of improving the firing process.” Further, Examiner states that the Applicants are merely combining prior art elements according to known methods to yield predictable results.

Contrary to Examiner’s contention, Applicants submit that one skilled in the art would not have any motivation to combine the teachings of the indirect heating system of Prior Art with the coal dust ventilator mill of DE3841874. As shown and claimed by Applicants, the claimed invention separates finer particles from coarser particles resulting from the grinding of the solid fuel. A separator further separates the finest particles from the finer particles to provide fine particles. The fine particles are for burning in the combustion chamber, while the finest particles are provide to a dedicated burner via a dedicated pipe for burning in the combustion chamber.

Contrary to the claimed invention, DE3841874 shows a main burner-vapour burner system, as shown in Fig. 4, having a mill 2, a transition section 2, and a grader 1 to extract dust-poor vapour that is provided through a gas channel 61 to a vapour burner 63 and to extract a dust-rich mix that is provided through a coal dust channel to a main burner 64 (see col. 6, lines 22 – 65, Fig. 4). The coal is also directly fed to the main burner.

Applicants contend that one skilled in the art would not be motivated to combine the teachings of the indirect heating system of Prior Art with the direct-firing main burner-vapour burner system of DE3841874. Further, neither reference provides any motivation to provide finest particles of solid fuel to a dedicated burner for burning in a combustion chamber, as presently claimed by Applicants. Applicants submit that DE3841874 teaches away from the Applicants' claimed invention because DE3841874 provides an embodiment whereby a separator 35 (fig. 4d) is added to draw off the separated fine particle and provide the fine particles to main burner, which is similar to that disclosed in Prior Art.

Furthermore, Applicants submit that even if there is motivation to combine the teachings of Prior Art and DE3841874, the combined teachings would not result in the Applicants claimed invention of claim 1, as amended. As shown in Prior Art in Fig. 2, the gases and fine particles leaving the cyclone 5 are intercepted by a dust extractor 10 and provided to the main burner 70 for burning. As shown in DE3841874, the dust-poor vapour is provided directly to a vapour burner 63 in Fig. 4. Any particles in the dust-poor vapour is not filtered therefrom and then provided to the vapour burner as suggested by Examiner when combining the two references. Applicants submit that the teachings of DE3841874 would eliminate the need for the dust extractor of the Applicants' claimed invention, and the resulting system would be similar to that shown in Fig. 1 of Prior Art having no dust extractor, and thus teaches away from the use or need of a dust extractor.

Applicants therefore contend that claim 1 is not rendered obvious in light of Prior Art in view of DE3841874 for at least the reasons provided hereinbefore, and it is respectfully requested that the rejection be withdrawn and claim 1 be allowed.

Claims 2, 6, 7, and 12 variously depend on independent claim 1, and therefore are not rendered obvious by Prior Art in view of DE381874, and it is respectfully requested that these claims be reconsidered and allowed for at least the reasons provided hereinbefore.

2. Claim 3 stands rejected under 35 U.S.C. §103(a) as being unpatentable, whereby claim 3 has been found to be unpatentable over Prior Art in view of DE3841874 and further in view of DE3731271.

Claim 3 variously depends on independent claim 1, and therefore is not rendered obvious by Prior Art in view of DE381874 and further in view of DE3731271, and it is respectfully requested that this claim be reconsidered and allowed for at least the reasons provided hereinbefore.

3. Claims 4 and 8 stand rejected under 35 U.S.C. §103(a) as being unpatentable, whereby independent claim 4 has been found to be unpatentable over Prior Art in view of EP0747629.

Examiner contends that Prior Art discloses all the limitations of claim 4 except for the limitation that the finest particles are “then introduced into the combustion chamber via dedicated pipes and injectors downstream of main burners.” Examiner further contends that EP0747629 shows this limitation for the purpose of burning powdered fuel to reduce NOx. Consequently, Examiner finds that “[I]t would have been obvious to one of ordinary skill in the art to modify Prior art by including introduced into the combustion chamber via dedicated pipes and injectors downstream of main burners as taught by EP0747629 for the purpose of burning powdered fuel to reduce NOx.” Further, Examiner states that the Applicants are merely combining prior art elements according to known methods to yield predictable results.

Applicants traverse Examiner’s contention that the teachings of Prior Art and EP0747629, when combined, would result in the Applicants’ claimed invention of claim 4, as amended. EP0747629 shows a swirling type furnace in Fig. 1 having an upright combustion chamber 1 with a burner 2 for air-fuel mixture supply mounted on it front wall. The burner 2 is formed by a pair of ducts 2a and 2b for supplying the fuel-air mixture. (col. 6, lines 12-17) EP0747629 does not disclose an injector as recited in claim 4 of Applicants’ claimed invention. Specifically, neither Prior Art nor EP0747629 show, teach or suggest providing the finest particles “by a dedicated pipe to a dedicated injector to introduce the finest particles into the combustion chamber.”

Applicants therefore contend that claim 4 is not rendered obvious in light of Prior Art in view of DE0747629 for at least the reasons provided hereinbefore, and it is respectfully requested that the rejection be withdrawn and claim 4 be allowed.

Claim 8 has been canceled, and therefore the rejection is now moot.

4. Claim 5 stands rejected under 35 U.S.C. §103(a) as being unpatentable, whereby claim 5 has been found to be unpatentable over Prior Art in view of EP0747629 and further in view of Vatsky (4,270,895).

Claim 5 variously depends on independent claim 4, and therefore is not rendered obvious by Prior Art in view of EP0747629 and further in view of Vatsky, and it is respectfully requested that this claim be reconsidered and allowed for at least the reasons provided hereinbefore.

5. Claim 9 stands rejected under 35 U.S.C. §103(a) as being unpatentable, whereby claim 9 has been found to be unpatentable over Prior Art in view of DE3841874 and further in view of FR 2,534,359.

Claim 9 variously depends on independent claim 1, and therefore is not rendered obvious by Prior Art in view of DE381874 and further in view of FR 2,534,359, and it is respectfully requested that this claim be reconsidered and allowed for at least the reasons provided hereinbefore.

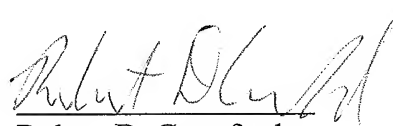
6. Claim 10 stands rejected under 35 U.S.C. §103(a) as being unpatentable, whereby claim 10 has been found to be unpatentable over Prior Art in view of DE3841874 and further in view of Tobias (6,369,680). Claims 10 has been canceled, and therefore the rejection is now moot.

7. Claims11 stands rejected under 35 U.S.C. §103(a) as being unpatentable, whereby claim 11 has been found to be unpatentable over Prior Art in view of DE3841874 and further in view of EP 976977. Claim 11 has been canceled, and therefore the rejection is now moot.

8. Applicants have also included herewith an English translation of the specification of the currently cited reference DE3841874.

9. Please charge the fee of \$460.00 for the two-month extension of time to Deposit Account No. 03-2578 Order No. VA30429. Any deficiency or overpayment should be charged or credited to Deposit Account No. 03-2578 Order No. VA30429.

Respectfully submitted,



Robert D. Crawford  
Registration No. 38,119

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ALSTOM Power Inc.  
2000 Day Hill Road  
Windsor, Connecticut 06095  
Phone: (860) 285-9117  
Fax: (860) 285-3515

## Specification

Method and arrangement for operating a coal dust ventilator mill for firing a boiler  
5 with coal dust.

### The current state of the art

Increasing water and ballast content in raw lignite is leading to serious consequences  
10 with regard to the ignition and combustion, where boilers are fired using coal dust.

A number of solutions have therefore come to be known whereby a small or large load  
of vapour/fine particulates mix, arising after the coal dust mill, is separated off from the  
coal dust/conveying gas mix, either within the grader or after it. The mix separated off is  
15 fed to special uses (eg. vapour burners (DD-PS 57 276), recovery of vapour for  
condensation (DE-PS 2 43 972), introduction of vapours into the combustion chamber or  
to ancillary heating surfaces (DD-PS 2 43 329), DD-PS . . . – WP F 23 K/2 93 184, DD-  
PS . . . – WP F 23 K/2 99 394), ignition dust recovery for coal dust pilot burners, recovery  
of igniting coal dust for supplementary burners (DD-PS 2 09 343, 2 29 043), or for vapour  
20 safety-bypassing (DE-AS 1 22 108, 12 08 158)).

The drawbacks with these methods of separation within the grader are that the grader  
has to be arranged in accordance with all of the output gas flow from the mill, also there is  
a higher level of wearing of the grader components; special separation components are  
25 needed in the grader and these bring about a further loss in pressure; further, a drive is  
needed for the removal of the separated gas, the grader process is affected by the  
additional components and clear separation of the vapours carrying the fine particulates  
from the coarse materials, particularly ballast constituents, is not possible. The presence of  
the vapour/conveying gas/coal dust mix in the grader means that separation of the vapours  
30 is costly.

For these reasons, attempts have been made to separate off the vapours inside the mill (DD-PS 2 45 369, DD-PS 63 957, 57 276). The drying of dust in the mill is substantially reduced by diverting a large part of the hot gas. Additionally the removal of fine particulates increases with increased gaps arising through the abrasion of corner casing;  
5 coarse dust is moreover also dealt with.

#### The aim of the invention

10 The aim of the invention is to improve milling, grading and firing, at low cost.

#### The nature of the invention

15 The aim of the invention is to find the conveying gas and/or dust immediately after the impacting wheel, using the speed of flow for effective firing and for optimal operation of the coal dust ventilator mill.

20 This is achieved in the invention by separating and drawing off a dust-poor and/or fine particulate-rich conveying gas mix from the side area of the centrally flowing dust-rich coal dust/conveying gas mix into the transverse section of the mill's outflow and/or to a transition section disposed after the transverse section of the outflow and/or by separating and drawing off a dust-poor and/or fine particulate-rich conveying gas mix in the transverse section of the outflow of the transition section.

25 To achieve this, dust-rich and dust-poor conveying-gas channels and/or cold and/or warm gas channels are connected into the transverse section of the mill's outflow and/or into a transition section disposed after the outflow cross-section and/or into the outflow transverse section of the transition section.

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### Example of implementation

An example of implementation is explained below in detail in connection with the annexed diagrams showing the following:

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Fig. 1 the coal dust conveying-gas profile in the outflow cross-section of the coal dust ventilator mill,

Fig. 2 connection of the pilot burner feed pipe into the transition section,

10 Fig. 3 inclusion of feed pipes into the transition section disposed after the mill inflow cross-section,

Fig. 4 the connection of coal-dust main-burner and pilot burner feed pipes into the mill outflow cross-section,

Fig. 5 connection of feed pipes into the transition section,

Fig. 6 connection of the cold gas channel into the transition section,

15 Fig. 7 connection of the warm gas channel into the transition sections and of the hot gas channel into the mill housing, with coal dust recovery equipment,

Fig. 8 separation off of unwanted cold and warm gas in the transition section after the mill,

Fig. 9 connection of the warm gas channel into the transition section,

20 Fig. 10 connection of the cold and warm gas channel into the transition section in order to form a multi-chamber grader,

Fig. 11 a lateral view of fig. 10.

25 In fig. 1, the coal dust ventilator mill 2 has impacting wheel boss 83, the oncoming angle 84, the impacting wheel 87, the mill housing 88, the motor-side lateral face 78, the mill door-side lateral wall 79, the spiral outer wall 82, the outflow cross-section 80 and the transition section 3 that is disposed on the transverse section 80 of the outflow and that is in the form of a diffuser.

There is, in each case, a gap 90 between the lateral faces of the impacting wheel 87 and the sides of the mill housing 88 and between the outer diameter of the impacting wheel 87 and the spiral, inner face 86 and/or the spiral, outer face 82. The transition section 3 has the outflow cross-section 81.

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The mode of functioning is as follows:

When the mill is running, flue gas 27 is sucked axially through the impacting wheel and conveyed via the outflow cross-section 80 into the transition section 3. At the same time coal 49 comes into the impacting wheel 87 with the flue gas 27, is there ground in the mill housing 88 and the impacting wheel 87 and is conveyed away, through the cross-section of the outflow 80, as a mix of coal dust and conveying gas 25. The form of the conveyor gas dust and the dust-distribution at the point of the cross-section 80 of the outflow is controlled by means of the following measures:

1. Through the arrangement of the oncoming angle 84 of the mill door and the associated effect on the dropping angle 85, of the coal 49, in the area of the impacting wheel 87;

2. Through the development of the impacting wheel boss 83 by controlling the mill control means 89 within the impacting wheel 87;

3. Through the diameter, the number and the height of the impacting plates of the impacting wheel 87;

4. Through the gap 90 between the lateral faces of the impacting wheel 87 and the sides 78; 79 of the mill housing 88 and/or between the outer diameter of the impacting wheel 87 and the spiral, inner face 86 or the spiral outer face 82.

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The dust distribution and gas flow 89 are affected by the sizing, development and arrangement of these elements, and a profile of the mix 25 of the coal dust and the conveying gas, at the point of the cross-section of the outflow 80, is produced. With this, the gap 90, in particular, affects the edge flow of the coal dust/conveying gas mix 25. The profile of the mix 25 of coal dust and conveying gas is drawn in for a set gap 90:

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The load “ $b$ ” (quantity of dust/gas) is concentrated in the area of the spiral, outer face 82 and the motor-side lateral face 78. The load “ $b$ ” is at a minimum in the area of the outflow cross-section 80 on the spiral inside 86 and in the area of the mill door-side lateral face 79. The gas speed “ $V$ ” of the coal dust/conveying gas mix 25 is at a maximum in the area of the outflow cross-section 80, on the spiral inside and on the mill door-side lateral face 79. The same applies to the temperature distribution “ $T$ ” of the conveying gas.

The distribution described is strongly influenced by the arrangement of the transition section 3 in the form of a diffuser. Where the transition section 3 as diffuser has a corresponding inclination and length “ $L$ ”, separation occurs in the edge zone, leading, as a result of turbulence 77, to diffusion of fine particulates in the area of the face of the diffuser incline, with the coarse dust remaining within the flow of the mix of coal dust and conveying gas 25. This gives relative concentration of fine particulates in the diffuser wall area over the cross-section 81, at the point of outlet or cross-section 81 or outflow cross-section in the area of the transition section 3 outlet, as shown for example for the dust  $D_{0.063}$  (passage through filter with 0.063 mm mesh size).

The main burner/ignition-dust burner system has the mill 2 with the transition section 3 and the grader 1 (fig. 2). The coal dust channel 5 with slide plate 97 and the main burner 64 adjoin the grader 1. The transition section 3 has the diffuser-type enlargement that opens, via the transverse section 81 of the outflow, into the ignition dust channel 17 and the ignition burner 22.

The mode of functioning is as follows:

When running the mill 2 and loading with coal 49 via the flue gas return feed 4, a conveying gas profile is formed, in the area of the outflow cross-section 80, that, in the area of the spiral outer wall 82, is enriched with dust. The coal dust/conveying gas mix 25 will thereby mainly flow into the grader 1. As a result of the diffuser-type enlargement of the transition section 3, turbulence 77 develops in the zone of the high, narrow cross-section 95, with diffusion of fine particulates in the diffuser area. In this way, fine

particulates are directed into the outflow cross-section 81 formed by the diffuser. The high coal dust concentration in the area of the spiral outer face 82 is used, by means of the turbulence 77 and the development, through the gas flow 24, of a diffuser, to draw off a relatively large amount of fine particulates into the outflow cross-section 81 and direct them via the ignition dust channel 17 to the ignition burner 22. The relative utilization of the outlet speeds from the outflow cross-section 80 of the mill 2 is here also used to overcome still higher pressure losses, in the area of the ignition burner 22, through the arrangement of twisting bodies 96. These twisting bodies 96 or untwisted blocking means bring with them a high level of pressure loss, but nevertheless lead to a relatively good level of turbulence in the area of the ignition burner 22 and thereby to a stable ignition coal-dust flame. The greater part of the coal dust/conveying gas mix 25 goes to the main burner 64 via the grader 1 and the coal dust channel 5. The dust concentration is further increased over the course of the flow of the gas 24 in that there is a high, narrow suction cross-section 95 that is nevertheless kept clear of coarse dust through being close to the mill door-side lateral face 79. The coarse dust is mainly concentrated on the motor-side lateral face 78. Separate operation of the support burner and/or of the ignition burner 22 (fig. 2) occurs as follows:

By shutting the slide plate 97, a heavily ground coal dust/conveying gas mix 25 is directed via the channel 17 to the ignition and/or support burner 22, with minimal uptake of coal into the separation-mill-grader circulation, when the main burner 64 is not in operation.

Naturally, such support operation by means of channels that bypass the grader 1, can, when the grader outlet is blocked off, occur directly at the main burner, whereby parts of the main burner can additionally be blocked off (fig. 6).

The mill 2 is connected to the flue gas return feed 4 (fig. 3). The mill housing 88 holds the impacting wheel 87. The mill housing 88 opens into an outflow cross-section 80 and this is formed by the spiral inside 86, the mill door-side lateral face 79, the spiral outer

face 82 and the motor-side lateral face 78. The outflow cross-section opens into a transition piece 3 in the form of a diffuser, and has length “*L*”.

The outflow cross-section 81 is divided up into the vapour extraction cross-section 91.1; 91 (inclined hatching) and the separation dust cross-section 92 (shading rotated through 90°). The grader dust cross-section 92 opens into the grit return channel 93 that is interfaced with the flue gas return feed 4. The vapour extraction cross-section 91.1; 91 opens into the coal dust channel 5; 5.1 that is connected into the main burner 64.

Functioning is as follows:

If the mill 2 is running, flue gas 27 is conveyed with coal 49, via the flue gas return geed 4, into the mill 2 and is removed as a mix of coal dust and conveying gas 25 via the outflow cross-section 80. The separations 90 between the impacting wheel 87 and the mill housing 88 and the arrangement of the impacting wheel boss 83 and the oncoming-coal angle 84 are proportioned such that a dust-bearing and dust-poor profile forms at the outflow cross-section 80. In this way, a dust-rich flow of coarse forms in the area of the faces 78; 82 of the outflow cross-section 80, while a dust-poor mix showing high outlet speeds forms in the area of the faces 79; 86. By giving the diffuser-inclines of the transition section 3 a set, relatively long length “*L*”, turbulence 77 develops in the edge area of the flow of the coal dust/conveying gas mix 25 and leads to marked relative enrichment of the fine particulates, as in  $D_{0.063}$  for example, on the diffuser side.

Because of the relatively high gas speed in the area of the mill door-side lateral face 79, a dust-poor mix will collect there and the vapour extraction cross-section 91, after the diffuser, can be formed vary large there. While the dust-rich coarse dust mix concentrates on the motor-side lateral face 78, the vapour extraction cross-section 91.1 is formed relatively narrow, for this reason. The profile means that the separation dust cross-section 92, preferably trapezoid in form in the area of the spiral, is wide in the area of the outer face 82 and is formed narrow in the area of the spiral, inner face 86, giving sufficient

selection of coarse dust and fine particulates or a lot of gas in the area of the main burner and little gas in the area of the grit return channel 93.

This arrangement takes effect particularly when running this ventilator mill burner system with limestone added, since the limestone ground in the mill contains relatively heavy particles that, in the coarse state in the centre of the separation dust cross-section 92, are thrown, at a greater speed of removal, directly into the grit return channel 93. The same applies to the flow of the coal dust/conveying gas mix 25 with coarse dust.

The vapour extraction cross-section 91.1; 91 is here of a size whereby up to 80%, for example, of the conveying gas is conveyed, with enough milled dust and a sufficiently large dust content, to the main burner, via the coal dust channels 5; 5.1. The coarse dust and lime particles, on the other hand, are thrown directly into the grit return channel 93 and then, with little gas, are conveyed back to the mill 2 via the flue gas return feed 4. The large extent of development of a distribution profile over the cross-sectional area of the outflow 80, and the size of the diffuser along its length "L", mean that sufficiently finely ground dust is provided across the transverse section 91.1; 91 without additional separation in the main burner 64, while only a gas-poor mix of coarse dust reaches the grit return channel 93 via the separation dust cross-section 92. If the grit return mix still carries too much gas, by disposing fewer grader components in the grit return channel 93 or by interposing a cyclone (fig. 3c), a waste gas pipe 44 can optionally be connected into the vapour burner 53 or directly into the main burner 64.

The additional shunting off or extraction of further gas components with a content of fine particulates from the grit return channel 93 occurs by means of the funnel-shape of the intake to the grit return after the separation dust cross section 92 (fig. 2a), by means of gas bypasses or louvered apertures between the grit return channel 93 and the coal dust channels 5; 5.1 (fig. 2b) or by appropriate combination of such measures.

The new system has the advantage that, because of the strong distribution profile at the point of the outflow cross-section 80 and the reinforcement of enrichment with fine particulates by means of the diffuser of the transition section 3, there is such marked separation of fine particulates with gas from coarse dust with little gas that the main burner can be stably run with an increase in milling capacity, without a grader, and, in particular, the marked abrasion effect of the limestone when operating with coal 49 and limestone does not have an adverse effect on the size of the grader 1 and the mill 2.

The main burner-vapour burner system has a mill 2 with a flue gas return feed 4 with a given cross-section (hatched) and the outflow cross-section 80 of the mill 2 (fig. 4b). The outflow cross-section 80 is divided up into the vapour extraction cross-section 91 that is disposed as a triangle in the area of the mill door-side lateral face 79 and the spiral inner face 86, for example, and the grader dust cross-section 92. The grader dust cross-section 92 opens into the transition section 3 to which the grader 1 is connected. The grader 1 is connected into the coal dust channel 5 with the slide plate 97 and the main burners 64. The vapour extraction cross-section 91 is connected to the vapour channel 61 and the vapour burner 63.

The whole outflow cross-section 80 of the mill 2 opens into the transition section 3 (fig. 4a). In the area of the mill door there is an even vapour extraction cross-section 91, on the spiral, inner side diffuser-type extension of the transition section 3, and this vapour extraction cross-section 91 passes over, on the mill door side of the transition section 3, into a further vapour extraction cross-section 91. The gas channel 61 with rectangular cross-section (shown hatched) is connected onto this slot-form lateral vapour extraction cross-section and, above the grader 1, passes over into a rectangular cross-section.

Functioning occurs as follows:

When the mill 2 (fig. 4b) is running and flue gas 27 is entering via the flue gas return feed 4 into the mill 2, the mix of coal dust and conveying gas 25 is conveyed through the outflow cross-section 80 that, like the dust profile "b" (fig. 1) in the area of the vapour

extraction cross-section 91, is relatively dust-poor and further characterized by high outflow speeds. On the other hand, in the grader dust cross-section 92, there is a dust-rich mix with relatively low outlet speeds in accordance with profile "b" and speed "V" (fig. 1). This coal dust/conveying gas mix 25 with a relatively large quantity of dust and relatively little conveying gas is conveyed into the grader via the transition section 3, is there separated and coarse dust is then fed back to the mill 2 through the grit return channel 93, while the graded coal dust/conveying gas mix 25 is supplied via the main burner's 64 coal dust channel 5 as a stable ignition mix. The dust poor mix, as vapour mix, reaches the vapour burner 63 via the vapour extraction cross-section 91 and the vapour channel 61 and substantially unloads the grader 1, thereby increasing the stability of ignition of the main burner 64 through the withdrawal of a substantial quantity of conveying gas. The high outlet speeds in the vapour extraction cross-section 91 are utilized in forming the vapour channel 61 relatively long, such that, at a point on the vapour burner 63 lying above the main burner 64, the dust poor vapour mix that is blown in there does not adversely affect the ignition of the main burner.

The additional gain in pressure is used by the high outlet speeds in cross-section 91 (fig. 4d) to direct the vapour mix into a separator 35, to draw off the separated fine particulates via a pipe 39 and, for example, to allocate a finger of dust to the main burner 64 while the waste gas is conducted into the combustion chamber or into the boiler's ancillary heating surfaces, via the vapour burner 63 or an aperture.

It is however also possible to feed the vapour channel 61 back into the main burner 64 or into the coal dust channel 5 (fig. 4c) and to thereby produce a mix 25 of coal dust and conveying gas. This has the advantage that an enormous quantity of gas is conducted away via the cross-section 91 and the grader 1 is bypassed. In this way, the grader 1 can be discharged on the conveyor-gas dust-side and a lesser build-up of pressure in the grader 1 is then necessary. This leads to an increase in the throughput of conveying-gas dust through the mill 2, without the mill 2 temperature falling.

Lateral suction of the vapour mix from the cross-section 91 promotes further separation of dust and gas (fig. 4a). By rerouting the gas, there can additionally be selection here such that the vapour channel 61 is discharged of further fine particulates. This is achieved in particular by having the vapour extraction cross-section in the area of the diffuser-side incline as a low but wide slot, so that turbulence developing with the excess flow soon breaks down and the dust particles cannot follow the bypass flow.

When the slide plate 97 is closed, the volume of conveying gas and the coal delivery to the mill 2 is markedly throttled and most of the ground material of the mill 2 passes through the grit return feed 93 several times in circulation and is thereby ground very fine (fig. 4f).

With this, the finely ground, highly concentrated coal dust/conveying gas mix 25, which shows excellent ignition behaviour, is blown into the vapour burner 63 via the vapour channel 61 and vapour burner 63. With oil burners and other ignition devices, this can also be ignited in a cold combustion chamber and used to start a boiler or as a stable ignition support flame for part loads, maintaining operation and for peak loads. The separator 35 can of course be connected in as a grader bypass (fig. 4e).

In this solution, the vapour channel 61 is all conducted into the separator 35 and its waste gases are shunted off into the coal dust pipe 5 or into the burner 64. With this, the separator is operated by the pressure gain of the vapour pipe 61 in relation to the pressure loss of the main flow via the grader 1.

In this case, the fine particulates separated off in the separator 35 can, according to choice, either be bunkered for starting-up and support or can be conducted directly via ignition dust pipes to a support or ignition burner and be stably burnt.

It is however also possible to feed the waste gases of the separator into the suction side of the mill 2 or to an ancillary heating surface, in the combustion chamber or in the flue gas channel before the induced draught.

5 The mill 2 has the transition section 3 and the following grader 1 (fig. 5). The vapour channel 61 is placed above the high, narrow extraction cross-section 95 as a vapour extraction cross-section 91. The channel 21 is connected with the low, broad extraction cross-section 94 via the vapour extraction cross-section 91.

10 Functioning is as follows:

If the mill 2 is fed with a flow of flue gas, via the flue gas return feed 4, and with coal 49, then the flow formed from the coal dust/conveying gas mix 25 develops at the outflow cross-section 80 of the mill 2.

15 Dust-poor yet gas rich mix is to be extracted via the vapour channel 61. This is achieved by disposing a vapour cross-section 91 in the area of the dust-poor flow on the spiral, inner face 86 and on the mill door-side lateral face 79, by arranging a narrow, relatively high extraction cross-section 95. This gives a relatively large extraction cross-section in the area of the dust-poor mix. Although the very high arrangement of the cross-section above the turbulent flow 77 with diffusion of fine particulates means that a  
20 relatively large amount of fine particulates go into the vapour channel 61, this is not accentuated because of the arrangement of the extraction cross-section in the area of the dust-poor flow.

25 If, on the other hand, vapour is extracted in the area of the flow of the gas-rich mix from the area of the spiral outer face 82 or the motor-side lateral face 78, then this extraction cross-section 91 must be designed as a low, broad extraction cross-section 94. In this case, in spite of the same cross-sectional area 94, a relatively dust-poor mix can be extracted because the turbulence 77 only develops above the flow path and, because of the  
30 low height of the cross-section, this diffusion of fine particulates is not carried into the



cross-section 94. Hence there will be a relatively dust-poor mix of the flow of gas 24 in the channel 21.

The extraction cross-section is designed as a high, narrow cross-section 95 or low, broad one 94 in the area of the transition section 3, in order to proportion the fine particulates or overall dust content of the conveying gas mix that is extracted by means of the flow of the gas 13; 24.

The solutions described above achieve the following advantages:

1. The high levels of outlet energy and speeds at the mill outlet, together with little dust, is used to exclude dust-poor components from the grading, thereby discharging the grader of these.
2. The system needs a lower level of pressure loss, in connection with which the performance of the mill can be increased.
3. The grader can be smaller, wearing in it is reduced and its grading capacity is increased.
4. The installation can be run without a grader.
5. It is possible to include an ignition burner, with dust enrichment, without additional separation units such as cyclones for example.
6. Abrasion-intensive sealing measures for the mill housing, between the impacting wheel and mill housing. It is possible to forego costly adaptation of the oncoming-coal incline or of the mill boss, in order to moderate the dust profile by means of the removal cross-section.

7. The mill can additionally be run with limestone.

8. Vapour-burner and ignition dust burner channels, and also the grader bypasses, can be provided in existing systems without great expense.

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The grader 1 and the coal dust mill 2 are connected to each other by the transition section 3 (fig. 6).

10 The flue gas return feed 4 is connected into the suction side of the mill 2. The grader 1 has a coal dust channel 5. The cold and warm gas channels 6; 7, which are formed by the lateral parts 6.1; 7.1 and the wall sections 1.1; 1.2 of the grader 1, are connected into the transition section 3 above the openings 8; 9. The cold or warm channels 6; 7 are connected to the coal dust channel 5 via the openings 10; 11.

15 The opening 9 of the vapour channel 61 with vapour burner 63 can optionally be connected in place of the warm gas channel 7. The adjustable valves 26, the drive 30 of which is connected to the control 28 that has the thermometer 29 applied to it, are disposed in the cold and/or warm channel 7. The connection of the hot gas channel 33 into the transition section 3 (fig. 7) occurs by means of the hood 16 and opening 14 in the  
20 outlet area 12 of the mill 2. The interfacing of the cold gas channel 6 with the transition section 3 (fig. 8) adjoins the diverter 19 in the outlet area 12 of the mill 2.

The functioning is as follows:

25 Cold or warm gas 24.1; 24 lightly loaded with dust is conducted, from the overall volume of gas 23, via the openings 20; 8; 9 and cold or hot gas channels 6; 7 directly from the transition section 3, after the milling outlet 12.

30 The warm gas 13 that is lightly loaded with dust is conducted, from the overall gas 23, via the hood 16, opening 14 and hot gas channel 33 (fig. 7; 8). This gas 13; 24; 24.1 only carries a very small coarse dust component.

Because of the extraction, this quantity of dust and gas component no longer needs to be graded. The grader 1 is discharged of this quantity of gas 13; 24; 24.1 with the feeding of it 13; 24; 24.1 into the mixture of coal dust and conveying gas 25 after the grader 1 or, where applicable, into the vapour burner 63 (Fig.6).

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The pressure difference over the grader 1 determines the quantity of gas 13; 24; 24.1 to be extracted or directed outside the grader 1 into the 'short-circuit'. The quantity of gas 24.1 conducted away is increased by the dynamic outflow pressure.

10 The reduced gas quantity in the grader 1 further brings about a reduction in the pressure loss in the said grader 1, thereby reducing the gas quantities 13; 24; 24.1. In equipment without valves 26 in the channels 6; 7; 33, there is a balance between cold and hot gas 24; 24.1 and pressure loss over the grader 1. The grader rebound component increases with reduction in flow in the grader 1, and with this the content of fine  
15 particulates after the grader 1 increases without there being any further components.

Material wearing is reduced by the lesser quantity of gas in the grader 1. With connection of the slide plate or valves 26 into the channels 6; 7; 33, the quantity of flue gases 27, can within limits, be controlled by means of the flue gas return feed 4, as a result  
20 of the change in pressure losses after the mill 2, without costly intervention or components on or in the flow in the flue gas return feed. It is also possible to regulate the temperature 29 after the mill 2 by means of an adjuster 28, by changing the position of the valves 26 to the given set, required value. Abrasion in the channels 6; 7; 33 or valves 26 is slight, since the dust content is mainly one of fine particulates with a low SiO<sub>2</sub> content.

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There is a minimum area ratio between the channels 6; 7; 33 and the sectional area of the ground material outlet that needs to be maintained in order to keep the gas dynamics.

With this, the following advantages are gained:

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1. Reduced abrasion in the grader
2. Increase in the quantity of fine particulates after the grader, through improved reflection conditions
3. Raised post-milling temperature through increased sucking-in of hot gas
- 5 4. Low implementation costs
5. Simple control and operation
6. No additional drives needed
7. Increased mill performance
8. Possibility of subsequent installation in existing units
- 10 9. Reduction in the size of the grader because of reduced quantities of gas in it.

The transition section 3 is interfaced with the warm gas channel 7 on the mill suction side 15 (fig. 9) via the opening 14. The opening 32 is displaced toward the opening 14 immediately after the impacting wheel ledges 31, in the area 18 of the milling chamber-side lateral face, the hot gas channel 33 with valve 26 being connected into the said opening 32. The hot gas channel 33 is cleaned by the warm gas channel 7 and forms the dry channel 34. The dry channel 34 is connected into the separator 35 that is connected to the bunker 37 via the loading valve 36. The outlet 38 of the bunker 37 is connected to the burner 41 disposed on the boiler combustion chamber 40. The separator's 35 exhaust 42 is either interfaced with the mill 2 via the pipe 43 or with the combustion chamber 40 via the waste gas 44 and vapour burner 45.

The functioning occurs as follows:

From the mill 2, flue gas 27 is sucked out of the combustion chamber 40, via the flue gas return feed 4, and goes, together with the coal 49 to be milled, into the mill 2. Warm gas 13 with fine particulates 46 is drawn in, from the coal dust/conveying gas mix 25, via the opening 14. Because of the loading on the mill and the distribution of coal 49 on the mill suction side 15, a slight, but finely ground quantity, of dust is removed. Additionally, hot gas 47 reaches the hot gas channel 3 and the warm gas channel 7, via the opening 32. The quantity of hot gas 47 is controlled by the valve 26 such that the corresponding

degree of drying of the dust is reached so that the fine particulates 46 reach the separator 35, sufficiently dry, via the dry channel 34. The waste gas 48 either goes back into the mill 2 via the pipe 43 or goes into the combustion chamber 40 via the pipe 44 and the vapour burner 45.

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The cold gas channel 6, functioning as a part-chamber grader, and the warm gas channel 7, are interfaced with the transition section 3 (fig. 10) at the openings 8; 9, the said cold and warm channels forming, with the grader 1, the multi-chamber grader (fig. 10; 11). The adjustable grader elements 52; 53 are placed inside the channels 6; 7. The grader 1 has the grit return feed funnel 54 and the grit return feed 55. The channels 6; 7 likewise have the further grit return feed funnel 56 and the grit return feed 57.

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The functioning is as follows:

The flue gas 27 and the coal 49 reach the mill 2. Post-mill gas 58 is directed as a coal dust flue gas mix into the transition section 3. A controllable gas/dust mix 13; 24.1 is diverted and drawn, via the controllable adjusting valves 50; 51, into the channels 6; 7 acting as a chamber part-graders. The adjusting valves 50; 51 are sized such that they form, in the vertical setting, an extension of the grader partition and are placed at the end and central in relation to the incline of the transition section 3. In the closed position, the adjusting valves 50; 51 lie on the inclines of the transition section 3, thereby closing of the oncoming flow from the cold and/or warm gas channels 6; 7.

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In the most open setting, the adjusting valves 50; 51 open as far as the vertical of the outlet cross-section 80 of the mill 2. The warm 13 and cold gas 24.1 is directed to the given side of the mill in the channels 7;6 via the valves 50; 51 that can be thus adjusted. The grader elements 52; 53 are adjusted according to the required dust-particle size. The separated coarse product 59 of the channels 6; 7 goes into the grit return funnel 54 of the grader 1 via the grit return funnel and channels 56; 57. With the gas component/part chamber grading, the post-milling gas 58 is divided up such that a large gas component, 40% of the graded quantity for example, flows into the channels 6; 7 as a gas component

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13; 24.1. The remaining gas bearing a lot of dust, 80% of the overall dust load for example, flows through the grader 1 that is fitted with reinforced grading components in accordance with the high dust content.

5       The grit 59 separated from the channels 6; 7 is conducted, via the grit return feed 57, directly into flue gas return feed 55. With this arrangement of division of gas in grader sections, in a multi-chamber grader, the pressure loss over the grader 1 is substantially reduced, whereby the gas flow of the grit bypass, through the return feeds and into the grader 1, is very slight.

10       The following advantages are thereby obtained:

1. Reduced pressure loss in the mill installation
2. A small grader
- 15    3. Grading of granular material with a large dust content and enhanced pulverization
4. Separately adjustable grader chambers, in accordance with the given application
5. Installation in existing equipment at low cost
6. Increased throughput of raw lignite, and this also with a raised ash content in
- 20    the raw lignite.
7. Grading of low-heat fuel.

Of course, all variations described can be combined with each other according to choice, such that, in particular, the separating off of dust-poor conveying gas carrying  
 25    little or a lot of fine particulates, bypassing the grading, can be used to operate ignition, support and vapour burners in order to raise the performance of the ventilator mill and to reduce abrasion; it can also be used to produce, bunker and store fine particulates separately. The opening and closure of dust-poor conveying gas channels in the edge area of the oncoming flow cross-section of the mill or the transition section can be used to  
 30    reduce abrasion in the mill system. Here, by cutting-off the conveying gas channel 6 (fig.

6) and connecting the conveying gas channel 7, the dust load at the point of the outflow cross-section in particular is directed in the direction of the flue gas return side or spiral inner side and with this the mill abrasion increases in this area, while there is relief of abrasion of the mill on the motor side and/or the spiral, outer side. With this, it is possible to achieve further reduction in abrasion and/or lengthening of the service life of the mill. By connecting edge conveying-gas channels, the dust-poor gas component, arising through leakiness between the impacting wheel and the housing, can be directly used and costly sealing measures can be foregone.

A further advantage of the new mode of functioning in accordance with the invention, is that the additional suction removal of fine particulates with conveying gas via additional conveying pipes, immediately after the spiral outlet, discharges the grader and the grit return feed of these fine particulates.

Reflection, deflection and milling conditions are, in this way, decisively improved. This provides the prerequisite for producing more fine granular material without additional loss in pressure.

Abrasion in the mill is decisively reduced.

By reducing the quantities of grit fed back and/or the component of fine granular material, the mill is fed grit dust that is relatively moister, for drying. This increases the drying effect and additionally enables a lower, permissible temperature, after the grader, for operating the mill.